

design idea

Precision Constant-Current Sink Provides Wide, Close-to-the-Rail Compliance

Alfredo H. Saab and Shasta Thomas, Maxim Integrated Products Inc.

A precision current sink can be used to generate a voltage bias for sensors, amplifiers and other analog circuits. They can also generate a reference voltage (across a resistor in series with its output) referred to voltage levels that are variable or well above the common equipotential. Such current sinks consist of a voltage reference, an error amplifier, a current-sense resistor and an output device—usually one capable of handling a useful amount of power, and rated for voltages at the expected upper limit of the output-compliance range.

Desirable characteristics for this type of circuit block include a very large dynamic output impedance, stability with any load type (resistive or reactive) and stability over the allowed ranges of temperature, power-supply voltage and compliance voltage (upper and lower limits).

The circuit of Figure 1a, with component values as shown, produces a current of 1 mA with a compliance range of 0.7V to 50V, and a dynamic output impedance of 10₆ ohms. The circuit of Figure 1(b) can do the same, with a compliance range that extends down to 0.25V, but it requires an extra, separate reference voltage.

The reference/amplifier function is implemented with a shunt regulator (MAX8515), and the power output device (BSS123) is a small n-channel MOSFET with maximum V_{DS} of 100V (V_{DS} is the current sink's higher compliance limit). The current sample is obtained from a resistor (R_{SOURCE}) in series with the BSS123 source. You can adjust this current by changing the resistor value according to the following equation:

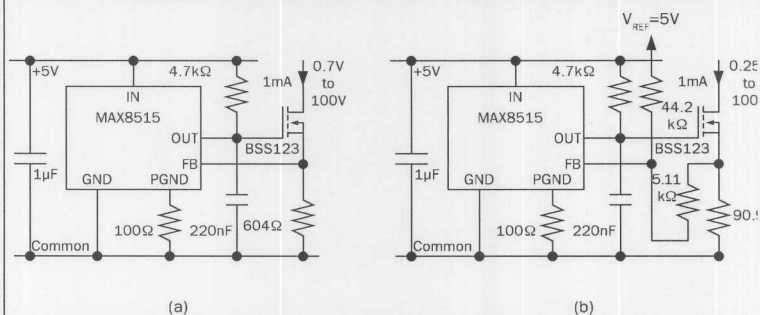
$$\text{Circuit of Figure 1a: } I_{\text{SINK}} = 0.6\text{V}/R_{\text{SOURCE}}$$

$$\text{Circuit of Figure 1b: } I_{\text{SINK}} = 0.091\text{V}/R_{\text{SOURCE}}$$

Other performance includes the stability of sink current with output voltage (Figure 2), and the variation of sink current with temperature over the range 0° to +50°C (±0.75%, Figure 3).

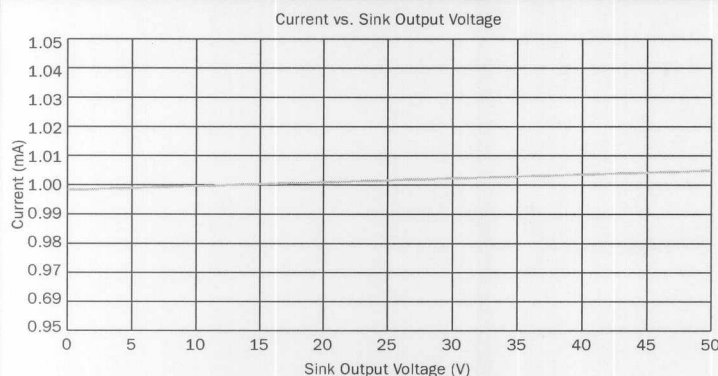
Maxim Integrated Products, Inc.
Sunnyvale, CA.
(408) 737-7600.
[www.maxim-ic.com].

figure 1



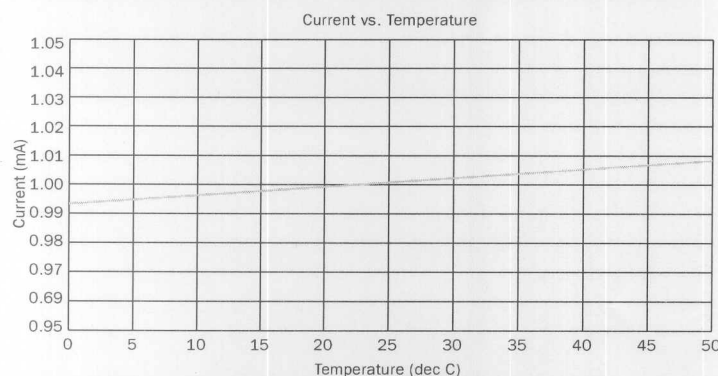
These current-sink circuits produce 1 mA with an output-compliance range of 0.7V to 50V (a), and 0.25V to 50V (b).

figure 2



Sink current vs. output voltage for the circuit of Figure 1a.

figure 3



Sink current varies ±0.75% over the temperature range shown, for the circuit of Figure 1a.